भारतीय मानक
Indian Standard

IS 516 (Part 5/Sec 4) : 2020

दृढ़ीकृत कंक्रीट — परीक्षण पद्धतियाँ

भाग 5 दृढ़ीकृत कंक्रीट का अविनाशी परीक्षण

खण्ड 4 प्रतिक्षेप हथौड़ा परीक्षण

(पहला पुनरीक्षण)

Hardened Concrete — Methods of Test

Part 5 Non-Destructive Testing of Concrete

Section 4 Rebound Hammer Test

(First Revision)

ICS 91.100.30

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुरशाह ज़फर मार्ग, नई दिल्ली – 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI-110002
www.bis.gov.in www.standardsbis.in

August 2020 **Price Group 5**

Cement and Concrete Sectional Committee, CED 02

FOREWORD

This Indian Standard (Part 5/Section 4) (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Cement and Concrete Sectional Committee had been approved by the Civil Engineering Division Council.

Testing plays an important role in controlling the quality of cement concrete work. Systematic testing of the raw materials, the fresh concrete and the hardened concrete, is an inseparable part of any quality control programme for concrete. This helps achieve a higher efficiency of the materials used and greater assurance of the performance of concrete, in regard to workability, strength and durability. The test methods used should be simple, direct and convenient to apply. This standard was formulated with this objective in view.

This standard was first published in 1959. In this revision, it was decided to review and update the various existing test methods of hardened concrete. The revision of the standard is being brought out taking into consideration the latest international practices and developments in this field in the country, and also introduces certain new test methods, wherever required. In the process, the various existing test methods covered in IS 516 : 1959 'Methods of tests for strength of concrete' have been revised taking into consideration primarily the corresponding ISO standards while also examining the other best practices world over and in the country. In addition, test methods for determination of additional properties have been included in areas such as permeability, initial surface absorption, corrosion of reinforcement, carbonation of concrete (field test), accelerated carbonation test, creep of concrete and flexural strength and toughness parameters of fibre reinforced concrete. Also, for better understanding and implementation, some of the other test methods for hardened concrete which were spread over in number of other Indian Standards have been brought together under the fold of IS 516 as its various parts, such as the splitting tensile strength, ultrasonic pulse velocity test, rebound hammer test, bond in reinforced concrete, and determination of water soluble and acid soluble chlorides. This is with a view to making the standard complete in all respects, and rendering it a comprehensive source of provisions for testing of hardened concrete and reference in other Indian Standards.

In this revision, IS 516 is split into 12 parts. The other parts in the series are:

Part 1 Testing of strength of hardened concrete
Part 2 Properties of hardened concrete other than strength
Part 3 Making, curing and determining compressive strength of accelerated cured concrete test specimens
Part 4 Sampling, preparing and testing of concrete cores
Part 6 Determination of drying shrinkage and moisture movement of concrete samples
Part 7 Determination of creep of concrete cylinders in compression
Part 8 Determination of modulus of elasticity
Part 9 Determination of wear resistance
Part 10 Determination of bond in reinforced concrete
Part 11 Determination of Portland cement content of hardened hydraulic cement concrete
Part 12 Determination of water soluble and acid soluble chlorides in hardened mortar and concrete

The standard (Part 5) specifies non-destructive test methods for use on hardened concrete in the following sections:

Sect 1 Ultrasonic pulse velocity
Sect 2 Half-cell potentials of uncoated reinforced steel in concrete
Sect 3 Carbonation depth test
Sect 4 Rebound hammer Test

In view of the limitations of each method of non-destructive testing of concrete, it is essential that the results of tests obtained by one method should be complemented by other tests and each method should be adopted very carefully.

(*Continued to third cover*)

Indian Standard

HARDENED CONCRETE — METHODS OF TEST

PART 5 NON-DESTRUCTIVE TESTING OF CONCRETE

Section 4 Rebound Hammer Test

(First Revision)

1 SCOPE

This standard (Part 5/Sec 4) covers the objective, principle, apparatus and procedure of rebound hammer test for determination of the rebound number of hardened concrete using a spring-driven steel hammer. In addition, influence of test conditions and some general guidance on the interpretation of test results are also given.

NOTE — The test method is not intended as an alternative for the compressive strength determination of concrete; but with suitable correlation, it can provide an estimate of *in-situ* strength.

2 REFERENCES

The standards listed below contain provisions which through reference in this text, constitutes provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below:

IS No.	*Title*
516	Hardened Concrete — Methods of test
(Part 1/Sec 1) : 2020	Testing of strength of hardened concrete, Section 1 Compressive, flexural and split tensile strength (*first revision*)
(Part 5/Sec 1) : 2018	Non-destructive testing of concrete, Section 1 Ultrasonic pulse velocity testing (*first revision*)
IS/ISO 16269 (Part 4) : 2010	Statistical interpretation of data: Part 4 Detection and treatment of outliers

3 OBJECTIVE AND PRINCIPLE OF TEST

3.1 Objective

The rebound hammer method could be used for,

a) assessing the likely compressive strength of concrete with the help of suitable correlation between rebound index and compressive strength developed in accordance with **5.2**;
b) assessing the uniformity of concrete quality;
c) assessing the quality of the concrete in relation to standard requirements; and
d) assessing the quality of one element of concrete in relation to another.

3.2 Principle of Test

When the plunger of rebound hammer is pressed against the surface of the concrete, the spring-controlled mass rebounds and the extent of such rebound depends upon the surface hardness of concrete. Based on the rebound distance of the spring-controlled mass after it impacts the plunger or based on the ratio of the hammer speed after impact to the speed before impact, a rebound number is produced. Rebound number produced based on two measurement principles are not comparable. The surface hardness and therefore the rebound is taken to be related to the compressive strength of the concrete. The rebound is read off along a graduated scale, recording paper or an electronic display and is designated as the rebound number or rebound index.

4 APPARATUS

4.1 Rebound Hammer

It consists of spring-loaded steel hammer (mass) that strikes the metal plunger in contact with the concrete surface when released.

The impact energy required for rebound hammers for different applications is given in Table 1.

Table 1 Impact Energy for Rebound Hammers for Different Applications

(*Clause* 4.1)

Sl No.	Application	Approximate Impact Energy Required for the Rebound Hammers Nm
(1)	(2)	(3)
i)	For testing normal weight concrete	2.25
ii)	For light-weight concrete or small and impact sensitive part of concrete	0.75
(iii)	For testing mass concrete, for example, in roads, air-field pavements and hydraulic structures	30.00

4.2 Abrasive Stone

It consists of medium-grain texture silicon carbide or equivalent material.

4.3 Testing Anvil

It consists of a steel cylinder with 150 mm diameter and 150 mm height. The hardness Rockwell C (HRC) value of the impact area shall be 64 to 68. The supplier/manufacturer of the rebound hammer should indicate the range of readings on the anvil suitable for different types of rebound hammers.

5 CHECKING OF APPARATUS

5.1 It is necessary that the rebound hammer is checked against the testing anvil as per **4.3** before commencement of a test and after completion of test to ensure reliable results.

NOTE — A properly operating rebound hammer and a properly designed anvil should result in a rebound number recommended by the manufacturer. Verification on the anvil does not guarantee that the hammer will yield repeatable rebound numbers at other points on the scale.

5.2 Procedure of Obtaining Correlation between Compressive Strength of Concrete and Rebound Number

Relationships between rebound number and concrete strength that are provided by instrument manufacturers shall be used only to provide indications of relative concrete strength at different locations in a structure. To use this test method to estimate strength, it is necessary to establish a correlation between rebound number and strength for a particular concrete and particular apparatus by any method given below.

5.2.1 *Correlation between Compressive Strength of Concrete and Rebound Number (Using Cube Compressive Strength)*

The most satisfactory way of establishing a correlation between compressive strength of concrete and its rebound number is to measure both the properties simultaneously on concrete cubes. The correlation shall be derived on project specific concrete cubes for all bigger projects. The general correlation can be derived from concrete cubes used in smaller projects in a region with similar materials including cement type and the same shall be repeated every year. For bigger projects atleast three cubes each for three different concrete grades shall be cast and tested for establishing the correlation. Cube specimens should be wet cured for 27 days and they should be removed from wet storage and kept in the laboratory atmosphere for about 24 h before testing. The concrete cube specimens are held in a compression testing machine under a fixed load, measurements of rebound number taken using the particular hammer/hammers for which conditions are to be established and then the compressive strength determined as per IS 516 (Part 1/Sec 1). The fixed load required is of the order of 7 N/mm^2 when the impact energy of the hammer is about 2.25 Nm. The load should be increased for calibrating rebound hammers of greater impact energy and decreased for calibrating rebound hammers of lesser impact energy. The test specimens should be as large a mass as possible in order to minimise the size effect on the test result of a full scale structure. 150 mm cube specimens are preferred for calibrating rebound hammers of lower impact energy (2.25 Nm), whereas for rebound hammers of higher impact energy, for example 30 Nm, the test cubes should not be smaller than 300 mm. Only the vertical faces of the cube as cast should be tested. At least nine readings should be taken on each of the two vertical faces accessible in the compression testing machine when using the rebound hammers. The points of impact on the specimen must not be nearer an edge than 25 mm and should be not less than 25 mm from each other. The same points must not be impacted more than once.

5.2.2 *Correlation between Equivalent Cube Compressive Strength of Concrete Cores and Rebound Number (Using Core Compressive Strength)*

To establish correlation between rebound number and strength for a particular concrete and particular apparatus, rebound numbers measured on the structure can be correlated with the few core strengths measured on the structure on corresponding members. At least two replicate cores shall be taken from at least six locations with different rebound numbers. The test conditions and surface conditions of the locations where strengths are to be estimated using developed correlation shall be similar to the locations used for development of correlation. For smaller projects the number of cores may be limited to six. The locations where these tests are conducted and cores are taken should have ultrasonic pulse value greater or equal to 3.50 km/s for grades $\leq$ M25, and 3.75 km/s for grades above M25, by direct method of probing, when tested as per IS 516 (Part 5/Sec 1).

NOTES

1 Predetermined curve prepared for similar concrete in the same region may be used for approximate estimation of strength of concrete used in the structural members tested for cases where correlation cannot be developed either by cube compressive strength or *in-situ* core strengths.

2 Different instruments of the same type may give rebound numbers differing from 1 to 3 units. Therefore, tests should be made with the same instrument in order to compare results. If more than one instrument is to be used, perform comparative tests on a range of typical concrete surfaces so as to determine the magnitude of the differences to be expected in the readings of different instruments.

For readings to be compared, the direction of impact must be the same or established correlation factors shall be applied to the readings. In the absence of data, manufacturer correlation for direction effect can be adopted.

6 PROCEDURE

6.1 For testing, smooth, clean and dry surface is to be selected. If loosely adhering scale is present, this should be rubbed off with a grinding wheel or stone. Rough surfaces resulting from incomplete compaction, loss of grout, spalled or tooled surfaces do not give reliable results and should be avoided.

6.2 The point of impact should be at least 25 mm away from any edge or shape discontinuity.

6.3 For taking a measurement, the rebound hammer should be held at right angles to the surface of the concrete member. The test can thus be conducted horizontally on vertical surfaces (preferably) or vertically upwards or downwards on horizontal surfaces. If the situation demands, the rebound hammer can be held at intermediate angles also, but in each case, the rebound number will be different for the same concrete.

NOTE – Digital angle gauges are available that can be attached to the body of the instrument to allow quick measurement of the angle with respect to horizontal. However, correlation taking into account the direction effect can also be developed between equivalent cube compressive strength of concrete cores (minimum 6 nos.) with rebound number in vertically upward or downward direction for the specific project.

6.4 Rebound hammer test shall be conducted around all the points of observation on all accessible faces of the structural element. Concrete surfaces 'shall be thoroughly cleaned before taking any measurement. Around each point of observation, six readings of rebound indices are taken and average of these readings after deleting outliers as per IS/ISO 16269 (Part 4) becomes the rebound index for the point of observation.

7 FACTORS INFLUENCING TEST RESULTS

7.1 The rebound numbers are influenced by a number of factors like type of cement and aggregate, surface condition and moisture content, age of concrete and extent of carbonation of concrete.

7.1.1 *Influence of Type of Cement*

Concretes made with high alumina cement can give strengths 100 percent higher than that with ordinary Portland cement. Concretes made with supersulphated cement can give 50 percent lower strength than that with ordinary Portland cement.

7.1.2 *Influence of Type of Aggregate*

Different types of aggregate used in concrete give different correlations between compressive strength and rebound numbers. Normal aggregates such as gravels and crushed rock aggregates give similar correlations, but concrete made with lightweight aggregates require special calibration.

7.1.3 *Influence of Surface Condition and Moisture Content of Concrete*

The rebound hammer method is suitable only for close texture concrete. Open texture concrete typical of masonry blocks, honeycombed concrete or no-fines concrete are unsuitable for this test. All correlations assume full compaction, as the strength of partially compacted concrete bears no unique relationship to the rebound numbers. Trowelled and floated surfaces are harder than moulded surfaces, and tend to overestimate the strength of concrete.

A wet surface will give rise to underestimation of the strength of concrete calibrated under dry conditions. In structural concrete, this can be about 20 percent lower than in an equivalent dry concrete.

7.1.4 *Influence of Curing and Age of Concrete*

The relationship between hardness and strength varies as a function of time. Variations in initial rate of hardening, subsequent curing and conditions of exposure also influence the relationship. The effect of age can be ignored for concrete above 14 days old.

7.1.5 *Influence of Carbonation of Concrete Surface*

The influence of carbonation of concrete surface on the rebound number is very significant. Carbonated concrete gives an overestimate of strength which in extreme cases can be up to 50 percent. The carbonation depth shall be checked in cases where the age of concrete is more than 6 months and same shall be reproduced in the test report.

7.1.6 *Influence of Vertical Distance from the Bottom of Concrete Placement.*

The influence of vertical distance from the bottom of concrete placement on the rebound number is very significant. Generally, a higher rebound number is observed near the bottom of concrete placement as during compaction, concentration of aggregates will be higher at the bottom.

7.1.7 *Influence of Surface Conditions Used in Development of Correlation Between Compressive Strength and Rebound Number*

The direct correlation between rebound numbers and strength of wet cured and wet tested cubes is not recommended. It is necessary to establish a correlation between the strength of wet tested cubes and the strength of dry tested cubes on which rebound readings are taken.

8 INTERPRETATION OF RESULTS

8.1 The rebound hammer method provides a convenient and rapid indication of the compressive strength of concrete by means of establishing a suitable correlation

between the rebound index and the compressive strength of concrete. The procedure of obtaining such correlation is given in **5.2**. In general, the rebound number increases as the strength increases but it is also affected by a number of parameters as mentioned in **7.1**. It is also pointed out that rebound indices are indicative of compressive strength of concrete to a limited depth from the surface. If the concrete in a particular member has internal micro-cracking, flaws or heterogeneity across the cross-section, rebound hammer indices will not indicate the same. As such, the estimation of strength of concrete by rebound hammer method cannot be held to be very accurate and probable accuracy of prediction of concrete strength in a structure can be up to ± 25 percent depending upon correlation curve and methodology adopted for establishing correlation between rebound index and likely compressive strength. If the relationship between rebound index and compressive strength can be checked by tests on core samples obtained from the structure or standard specimens made with the same concrete materials and mix proportion, then the accuracy of results and confidence thereon are greatly increased.

8.2 Because of the various limitations in rebound hammer test, the combined use of ultrasonic pulse velocity (UPV) test [IS 516 (Part 5/Sec 1)] and rebound hammer test is a must for proper interpretation. If the quality of concrete assessed by ultrasonic pulse velocity method is 3.50 km/s for grades ≤ M25, and 3.75 km/s for above M25 or above, only then the in-situ compressive strength assessed from the rebound hammer test is valid. This shall be taken as indicative of strength of concrete in the entire cross-section of the concrete member represented by the both tests.

8.3 In cases the quality of concrete assessed by UPV is doubtful, no assessment of concrete strength shall be made from rebound hammer test.

9 TEST REPORT

The report shall include the following:

a) Date/period of testing;
b) Identification of the concrete structure/element;
c) Location of test area(s);
d) Identification of the rebound hammer;
e) Details of concrete and its condition;
f) Date/time of performance of the test;
g) Test result and hammer orientation for each test area; and

NOTE – The report may include individual rebound hammer readings, if required.

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Cement and Concrete Sectional Committee, CED 02

Organization	*Representative(s)*
In Personal Capacity (*Grace Villa, Kadamankulam P.O. Thiruvalla* 689583)	Shri Jose Kurian (***Chairman***)
ACC Ltd, Mumbai	Shri Rajesh J. Modi Dr Manish V. Karandikar (*Alternate*)
Ambuja Cements Limited, Ahmedabad	Shri Umesh P. Soni Shri Sukuru Ramarao (*Alternate*)
Atomic Energy Regulatory Board, Mumbai	Shri L. R. Bishnoi Shri Sourav Acharya (*Alternate*)
Builders' Association of India, Mumbai	Shri Sushanta Kumar Basu Shri D. R. Sekor (*Alternate*)
Building Materials & Technology Promotion Council, New Delhi	Shri C. N. Jha
Cement Manufacturers' Association, Noida	Dr V. Ramachandra Ms Shashwati Ghosh (*Alternate*)
Central Public Works Department, New Delhi	Shri D. K. Garg Shri Naveen Kumar Bansal (*Alternate*)
Central Soil and Materials Research Station, New Delhi	Director Shri U. S. Vidyarthi (*Alternate*)
Central Water Commission, New Delhi	Director (CMDD) (N&W) Deputy Director (CMDD) (NW&S) (*Alternate*)
Conmat Technolgies Pvt Ltd, Kolkata	Dr A. K. Chatterjee Shri Subrato Chowdhury (*Alternate*)
Construction Chemicals Manufacturers' Association, Mumbai	Shri Samir Surlaker Shri Nilotpol Kar (*Alternate*)
CSIR – Central Building Research Institute, Roorkee	Shri S. K. Singh Shri Subhash Gurram (*Alternate*)
CSIR – Central Road Research Institute, New Delhi	Dr Rakesh Kumar Dr V. V. L. Kanta Rao (*Alternate*)
CSIR – Structural Engineering Research Centre, Chennai	Dr K. Ramanjaneyulu Dr P. Srinivasan (*Alternate*)
Delhi Development Authority, New Delhi	Shri Laxman Singh Shri Vijay Shankar (*Alternate*)
Department of Science and Technology, Ministry of Science and Technology, New Delhi	Shri S. S. Kohli
Engineers India Limited, New Delhi	Shri Rajanji Srivastava Shri Anurag Sinha (*Alternate*)
Gammon Engineers & Contractors Pvt Ltd, Mumbai	Shri Shriram B. Kulkarni Shri Rahul Biradar (*Alternate*)
Hindustan Construction Company Limited, Mumbai	Shri Satish Kumar Sharma Shri Mukesh Valecha (*Alternate*)
Housing and Urban Development Corporation Limited, New Delhi	Representative
Indian Association of Structural Engineers, New Delhi	Shri Mahesh Tandon Shri Ganesh Juneja (*Alternate*)
Indian Concrete Institute, Chennai	Shri Vivek Naik Secretary General (*Alternate*)

Organization	*Representative(s)*
Indian Institute of Technology Delhi, New Delhi	Dr Shashank Bishnoi Dr Dipti Ranjan Sahoo (*Alternate*)
Indian Institute of Technology Madras, Madras	Dr Devdas Menon Dr Manu Santhanam (*Alternate*)
Indian Institute of Technology Roorkee, Roorkee	Dr V. K. Gupta Dr Bhupinder Singh (*Alternate*)
Indian Roads Congress, New Delhi	Shri S. K. Nirmal Shri R. V. Patil (*Alternate*)
Military Engineer Services, Engineer-in-Chief's Branch, Integrated HQ of MoD (Army), New Delhi	Maj Gen S. K. Srivastav Shri Man Singh (*Alternate*)
Ministry of Road Transport and Highways, New Delhi	Shri Y. Bala Krishna Shri Sanjeev Kumar (*Alternate*)
National Council for Cement and Building Materials, Ballabgarh	Shri V. V. Arora Dr S. K. Chaturvedi (*Alternate*)
National Test House, Kolkata	Shri D. V. S. Prasad Dr Somit Neogi (*Alternate*)
Nuclear Power Corporation of India Ltd, Mumbai	Shri Arvind Shrivastava Shri Raghupati Roy (*Alternate*)
Nuvoco Vistas Corporation Ltd, Mumbai	Shri Pranav Desai Shri Ravindra Khamparia (*Alternate*)
Public Works Department, Govt of Tamil Nadu, Chennai	Superintending Engineer Executive Engineer (*Alternate*)
The India Cements Ltd, Chennai	Representative
The Indian Hume Pipe Company Ltd, Mumbai	Shri P. R. Bhat Shri S. J. Shah (*Alternate*)
The Institution of Engineers (India), Kolkata	Dr H. C. Visvesvaraya Shri S. H. Jain (*Alternate*)
The Ramco Cements Limited, Chennai	Shri Balaji K. Moorthy Shri Anil Kumar Pillai (*Alternate*)
Ultra Tech Cement Ltd, Mumbai	Shri Surya Valluri Dr M. R. Kalgal (*Alternate*)
Voluntary Organization in Interest of Consumer Education, New Delhi	Shri M. A. U. Khan Shri B. Mukhopadhyay (*Alternate*)
In personal capacity [*B-803, Oberoi Exquisite, Oberoi Garden City, Goregaon (East), Mumbai]*	Shri A. K. Jain
In personal capacity (*36, Old Sneh Nagar, Wardha Road, Nagpur)*	Shri L. K. Jain
In personal capacity (*EA-92, Maya Enclave, Hari Nagar, New Delhi*)	Shri R. C. Wason
BIS Directorate General	Shri Sanjay Pant, Scientist 'F' and Head (Civil Engineering) [Representing Director General (*Ex-officio*)]

Member Secretaries

Shri S. Arun Kumar
Scientist 'D' (Civil Engineering), BIS

Shri Milind Gupta
Scientist 'C' (Civil Engineering), BIS

and

Shrimati Divya S.
Scientist 'C' (Civil Engineering), BIS

Concrete Subcommittee, CED 2:2

Organization	*Representative(s)*
In Personal Capacity (*Grace Villa, Kadamankulam P. O. Thiruvalla* 689583)	Shri Jose Kurian (***Convener***)
ACC Limited, Mumbai	Shri Prahlad Majumdar Shri Anil Kulkarni (*Alternate*)
Ambuja Cement Limited, Ahmedabad	Shri Umesh P. Soni Shri Sukuru Ramarao (*Alternate*)
AFCONS Infrastructure Limited, Mumbai	Shri Manish Mokal
Association of Consulting Civil Engineers (India), Bengaluru	Shri Avinash D. Shirode Shri K. K. Meghashyam (*Alternate*)
Atomic Energy Regulatory Board, Mumbai	Shri L. R. Bishnoi Shri Sourav Acharya (*Alternate*)
Building Materials and Technology Promotion Council, New Delhi	Shri Pankaj Gupta
Bureau of Design for Hydel and Irrigation Project, Bhopal	Shri S. K. Khare Shri Bhagwati Prasad Gupta (*Alternate*)
Bureau Veritas India Ltd, Mumbai	Representative
Central Public Works Department, New Delhi	Shri D. K. Garg Shri Rajesh Khare (*Alternate*)
Central Soil & Materials Research Station, New Delhi	Shri Rajeev Kumar Shri Raj Kumar (*Alternate*)
Creative Design Consultants and Engineers Pvt Ltd, Ghaizabad	Shri Aman Deep Shri Manik Chatterjee (*Alternate*)
CSIR – Central Building Research Institute, Roorkee	Dr Rajesh Deolia Shri H. C. Arora (*Alternate*)
CSIR – Central Road Research Institute, New Delhi	Shri J. B. Sengupta Shri Satish Pandey (*Alternate*)
CSIR – Structural Engineering Research Centre Chennai	Dr B. H. Bharatkumar Dr P. Srinivasan (*Alternate*)
Department of Science and Technology, Ministry of Science and Technology, New Delhi	Shri S. S. Kohli
Elkem South Asia Pvt Ltd, Navi Mumbai	Shri Brajesh Malviya Shri Surendra Sharma (*Alternate*)
Engineers India Limited, New Delhi	Shri Rajanji Srivastava Shri Anurag Sinha (*Alternate*)
Gammon Engineers & Contractors Pvt Ltd, Mumbai	Shri Sudeesh Rajendran
Hindustan Constrution Company Ltd, Mumbai	Shri Satish Kumar Sharma Shri Khatarbatcha Jimmetain (*Alternate*)
Indian Concrete Institute, Chennai	Shri K. C. Tayade Secretary General (*Alternate*)
Indian Institute of Technology Delhi, New Delhi	Dr B. Bhattacharjee Dr Shashank Bishnoi (*Alternate*)
Indian Institute of Technology Kanpur, Kanpur	Dr Sudhir Mishra
Indian Institute of Technology Madras, Chennai	Dr Manu Santhanam Dr Radhakrishna G. Pillai (*Alternate*)

Organization	*Representative(s)*
Indian Institute of Technology Roorkee, Roorkee	Representative
Indian Society of Structural Engineers, Mumbai	Shri Umesh Joshi Shri Hemant Vadalkar (*Alternate*)
Irrigation and Power Research Institute, Amritsar	Chief Engineer (Research) Research Officer (*Alternate*)
Larsen and Toubro Limited, ECC Division, Chennai	Dr B. Sivarama Sarma Shri S. Manohar (*Alternate*)
Military Engineer Services, Engineer-in-Chief's Branch, Integrated HQ of MoD (Army), New Delhi	Maj Gen S. K. Srivastav Shri Man Singh (*Alternate*)
Ministry of Road Transport & Highways, New Delhi	Shri A. P. Pathak Shri A. K. Pandey (*Alternate*)
NBCC (India) Limited, New Delhi	Shri H. S. Yadav Shri Arun Kumar Sharma (*Alternate*)
National Council for Cement & Building Materials, Ballabgarh	Shri V. V. Arora Shri P. N. Ojha (*Alternate*)
National Institute of Technology Warangal, Warangal	Dr C. B. Kameswara Rao Dr D. Rama Seshu (*Alternate*)
Nuclear Power Corporation of India Limited, Mumbai	Shri Arvind Shrivastava Shri N. M. Rao (*Alternate*)
Pidilite Industries Limited, Mumbai	Dr Suguna Naik
Ready Mixed Concrete Manufacturers' Association, Mumbai	Shri Vijaykumar R. Kulkarni Shri Srirang Sondur (*Alternate*)
Research, Design & Standards Organization (Ministry of Railways), Lucknow	Joint Director Stdrs (B&S)/CB-I Joint Director Stdrs (B&S)/CB-II (*Alternate*)
RDC Concrete (India) Pvt Ltd, Thane	Shri Anil Banchhor Shri Simranjit Singh (*Alternate*)
Shapoorji Pallonji and Company Private Limited, Mumbai	Shri Girish Bonde Shri D. N. Vishwanath (*Alternate*)
Tandon Consultants Pvt Limited, New Delhi	Shri Mahesh Tandon Shri Vinay Gupta (*Alternate*)
Tata Consulting Engineers Limited, Mumbai	Shri S. N. Diwakar Shri Manos Kumar De (*Alternate*)
Ultra Tech Cement Ltd, Mumbai	Dr V. Ramachandra Dr A. K. Singh (*Alternate*)
Water Resource Department, Govt. of Madhya Pradesh, Mumbai	Shri S. K. Khare Shri B. P. Gupta (*Alternate*)
In personal capacity (*452, Sector 14, Sonipat, Haryana*)	Shri R. K. Jain
In personal capacity (*36, Old Sneh Nagar, Wardha Road, Nagpur*)	Shri L. K. Jain
In personal capacity [*B-803, Oberoi Exquisite, Oberoi Garden City, Goregaon (East), Mumbai*]	Shri A. K. Jain
In personal capacity (*EA-92, Maya Enclave, Hari Nagar, New Delhi*)	Shri R. C. Wason
In personal capacity (*M1 F1 VGN Minerva Apartments, Guruswamy Road, Nolambur*, *Chennai*)	Dr C. Rajkumar

Panel for Revision of Indian Standards on Test Methods for Concrete, CED 2:2/P7

Organization	*Representative(s)*
In Personal Capacity (*EA-92, Maya Enclave, Hari Nagar, New Delhi* 110064)	Shri R. C. Wason (***Convener***)
ACC Limited, Mumbai	Shri Avijit Chaubey Shri Prahalad Majumdar (*Alternate*)
AIMIL Ltd, New Delhi	Dr V. M. Sharma
Bureau Veritas India Limited, Bengaluru	Representative
Central Public Works Department, New Delhi	Shri Ajay Prakash Mathur Shri Naveen Kumar Bansal (*Alternate*)
Central Soil and Materials Research Station, New Delhi	Shri U. S. Vidyarthi
Contruction Diagnostic Centre Pvt Ltd, Pune	Shri Ravi Ranade
CSIR – Central Building Research Institute, Roorkee	Shri S. K. Singh Ms M. Surya (*Alternate*),
CSIR – Central Road Research Institute, New Delhi	Representative
CSIR – Structural Engineering Research Centre, Chennai	Dr S. Bhaskar Dr P. Srinivasan (*Alternate*)
Hindustan Construction Company Ltd, Mumbai	Shri Satish Kumar Sharma Shri Khatarbatcha Jimmetain (*Alternate*)
Hydraulic & Engineering Instruments, New Delhi	Representative
Indian Concrete Institute, New Delhi	Shri Ashok Kumar Tiwari
Indian Institute of Technology Delhi, New Delhi	Dr Shashank Bishnoi Dr Supratic Gupta (*Alternate*)
Indian Institute of Technology Madras, Chennai	Dr Radhakrishna G. Pillai Dr Ravindra Gettu (*Alternate*)
Larsen & Toubro Ltd, ECC Division, Chennai	Shri B. Sivarama Sarma Shri S. Manohar (*Alternate*)
National Council for Cement and Building Materials, Ballabgarh	Shri V. V. Arora Shri Puneet Kaura (*Alternate*)
Nuclear Power Corporation of India Ltd, Mumbai	Shri Arvind Shrivastava Shri A. K. Laharia (*Alternate*)
RDC Concrete (India) Pvt Ltd, Mumbai	Shri Anil Banchhor Shri Navneet Nair (*Alternate*)
Ready Mixed Concrete Manufacturers' Association, Mumbai	Shri Vijaykumar R. Kulkarni Shri N. G. Muralidharan (*Alternate*)
Stedrant Technoclinic Pvt Ltd, Bengaluru	Dr R. Nagendra Shri Sunil V. Sonnad (*Alternate*)
Unique Engineering Testing & Advisory Services, Surat	Shri Hitesh Desai Shri Nehal H. Desai (*Alternate*)
In personal capacity (*50 Mangla Apartments Kalkaji, New Delhi*)	Dr S. C. Maiti
In personal capacity (*Type IV/17, President's Estate, New Delhi*)	Shri K. H. Babu
In personal capacity (*Grace Villa, Kadamankulam P. O. Thiruvalla*)	Shri Jose Kurian
In personal capacity (*624, Ranisatinagar, Lane 6, Lodhi Marg, Ajmer Road, Jaipur*)	Dr P. S. Gahlot

(*Continued from Second Cover*)

This standard (Part 5/Sec 4) covers the procedure of rebound hammer test method for determination of a rebound number of hardened concrete using a spring-driven steel hammer. The significant modifications in this standard include,

a) procedures for developing correlation between compression test of concrete and rebound hammer have been elaborated and have been provided for both cube compressive strength and core compressive strength.
b) more details on the equipment and the testing anvil have been included.
c) the clause on influence of test conditions have been elaborated with inclusion of more factors.
d) use of a combination of rebound hammer and ultrasonic pulse velocity has been emphasized for proper interpretation of the results.

This test method shall be applicable as and when published, in place of the corresponding IS 13311 (Part 2) : 1992 ‘Methods of non-destructive testing of concrete: Part 2 Rebound hammer’, which shall stand withdrawn after the publication of this standard.

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

In reporting the result of a test or analysis made in accordance with this standard, is to be rounded off, it shall be done in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’. The number of significant places retained in the rounded off value should be the same as that specified value in this standard.

This Indian Standard has been developed from Doc No.: CED 02 (13832).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.gov.in

Regional Offices:		*Telephones*
Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	2323 7617 2323 3841
Eastern	: 1/14 C.I.T. Scheme VII M, V.I.P. Road, Kankurgachi KOLKATA 700054	2337 8499, 2337 8561 2337 8626, 2337 9120
Northern	: Plot No. 4-A, Sector 27-B, Madhya Marg CHANDIGARH 160019	265 0206 265 0290
Southern	: C.I.T. Campus, IV Cross Road, CHENNAI 600113	2254 1216, 2254 1442 2254 2519, 2254 2315
Western	: Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400093	2832 9295, 2832 7858 2832 7891, 2832 7892

Branches : AHMEDABAD. BENGALURU. BHOPAL. BHUBANESHWAR. COIMBATORE. DEHRADUN. DURGAPUR. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. JAMMU. JAMSHEDPUR. KOCHI. LUCKNOW. NAGPUR. PARWANOO. PATNA. PUNE. RAIPUR. RAJKOT. VISAKHAPATNAM.

Published by BIS, New Delhi